

REMARKS

Claims 1-22, all the claims pending in the application, stand rejected on prior art grounds. In addition, the drawings and specification are objected to. Applicants respectfully traverse these objections/rejections based on the following discussion.

I. The Prior Art Rejections

Claims 1-22 stand rejected under 35 U.S.C. §102(b) as being anticipated by Andricacos et al., herein after "Andricacos" (U.S. Patent No. 5,937,320). Applicants respectfully traverse this rejection because Andricacos does not teach or suggest the claimed "stabilizing copper layer on said barrier layer" as defined by independent claims 1 and 12 or the "copper and tin-based solder alloy bump" defined by independent claims 7 and 18.

The Office Action proposes that Andricacos discloses the claimed stabilizing copper layer in column 7, lines 1-10 where Andricacos discloses that a cap layer may be placed over the barrier layer and that this cap layer may be composed of copper. However, this capping layer is not equivalent to the claimed "stabilizing copper layer" (claims 1 and 12) or the "copper and tin-based solder alloy bump" (claims 7-18) because the capping layer in Andricacos merely performs the function of promoting uniformed nucleation of the barrier layer. Therefore, the capping layer would not be sufficiently thick or have sufficient material to balance the chemical potential gradient of copper across the barrier layer, as in the claimed invention. More specifically, Andricacos discloses a similar cap layer in column 6, line 29-34 and explains that the capping layers are a thin layer of less than 50 nm of a metal such as Au or Cu and are used to promote uniform nucleation of the barrier layer. Therefore, while Andricacos discloses that a very small amount of copper can be placed on the barrier layer to promote uniform nucleation, this does not teach or suggest the inventive structure that uses copper in a sufficient amount to balance the chemical potential gradient of copper across the barrier layer.

In addition, Andricacos requires that the capping layer cannot be used in embodiments that utilize copper for the terminal metal layer. More specifically, column 6, lines 33-34 prohibit the use of the capping layer when the terminal metal layer is copper. Therefore, according to the explicit teachings of column 6 lines 29-34 and column 7, lines 1-6 of Andricacos, the "optional embodiment" that uses the copper capping layer above and below the barrier layer cannot apply in situations where copper is used as the underlying metal layer below the barrier layer. This is directly contrary to the invention defined by independent claims 1, 7, 12, and 18 each of which explicitly provide "a first copper layer on said metal layer." This teaching of Andricacos actually teaches directly away from the invention. Thus, Andricacos teaches one ordinarily skilled in the art not to place a copper layer directly above the barrier layer when the underlying terminal metal layer is copper. Therefore, rather than anticipating the claimed invention, Andricacos actually demonstrates that the invention is indeed novel in that, prior to the invention, the conventional teachings required that a copper layer should not be included above the barrier layer when the underlying metal was copper.

Thus, it is Applicants position that Andricacos does not directly teach (or suggest) the use of "a stabilizing copper layer on said barrier layer" (claims 1 and 12) or "a copper and tin-based solder alloy bump on said barrier layer" (claims 7 and 18) because Andricacos teaches that no copper (even a small amount used for uniform nucleation of the barrier layer in a cap layer) should be placed over the barrier layer when the underlying terminal metal layer is copper. It logically follows that Andricacos cannot teach or suggest that the amount of copper within the barrier layer or within the solder alloy bump can comprise "a sufficient amount of copper to balance the chemical potential gradient of copper across said barrier layer" as defined by independent claims 1, 7, 12, and 18. Therefore, it is Applicant's position that independent claims 1, 7, 12, and 18 are not anticipated by Andricacos and are patentable over the prior art of record. Further, dependent claims 2-6, 8-11, 13-17, and 19-22 are similarly patentable, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw this rejection.

II. Formal Matters and Conclusion

With respect to the objections to the specifications, a substitute specification is provided herewith. With respect to the objection to the drawings, a Submission of Corrected Formal Drawings is submitted. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the objections to the specification, claims and drawings.

In view of the foregoing, Applicants submit that claims 1-22, all the claims presently pending in the application, are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary.

Please charge any deficiencies and credit any overpayments to Attorney's Deposit
Account Number 09-0458.

Respectfully submitted,

Dated: 9/7/04



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